ComS 425: High Performance Computing for Scientific and Engineering Applications

Spring 2007

I Teaching Staff

Class meets: at 9:30–10:50 TR, in Gilman 1810.
Recitation: at 14:10–15:00 T, in Gilman 1810.
Instructor: Masha Sosonkina.
Office: 236C Wilhelm; tel: 6751; email: masha@scl.ameslab.gov.
Office hours: By appointment.
Teaching Assistant: TBD.
URL for the class: `http://www.scl.ameslab.gov/~masha/ComS425`.

II Textbook

B. Wilkinson and M. Allen *Parallel Programming Techniques and Applications Using Networked Workstations and Parallel Computers*, 2nd edition, Prentice Hall, 2004.

URL for the book: `http://www.cs.uncc.edu/par_prog`

III Course description

Introduction to high performance computing platforms including parallel computers and workstation clusters. Discussion of parallel architectures, performance, programming models, and software development issues. Case studies of applications from science and engineering.

IV Course outline

1. Overview of high-performance computing: Motivation, Types of Parallel Computers and Applications (2—3 lectures).
2. Distributed-memory architectures. Problem partitioning Message-passing paradigm. Message Passing Interface (MPI). Embarrassingly parallel applications (3—4 lectures).
3. Shared memory parallel processing. OpenMP. Threads. Pipelined computations. Applications using shared memory (3—4 lectures).
4. Case study: parallel large-scale linear system solution (5—6 lectures).
5. Application performance analysis: performance metrics and benchmarks (4—5 lectures).
6. Program optimization: Load balancing, Termination detection, Algorithm-machine combination (3—4 lectures).
7. Project progress report presentations (2—3 lectures).

V Grading and important dates

- ◇ Class and recitation participation (including in-class quizzes) – 10%.
- ◇ Homeworks – 25%.
- ◇ Project: Abstract – 7%; In-class presentation – 13%; Final written project report (due Apr. 20)– 15%.
- ◇ Midterms (in class) Approximate dates: Feb. 13 – 15%; Mar. 22 – 15%
- ◇ No final but class meets on Apr. 30 at 14:15 – 16:15 in Gilman 1810.
- ◇ The recitations and lectures that are *NOT* held are to be announced, typically one week in advance.

VI Grade distribution

90% and up – A- and up
80% — 89% – B- — B+
70% — 79% – C- — C+
60% — 69% – D- — D+

VII Project assignments

The projects will consist of making a case study of a high-performance application, from your own research experience and/or research papers by others (not from the textbook). The projects are to be performed individually and all the applications are to be different. In the case of conflicts or problems with selecting an application, the instructor will make proper assignments. The projects will have deliverables by stages: abstracts, oral presentation, and final report.

Project deadlines (due in class)

- ◇ Feb. 22 — Application selection ends.
- ◇ Mar. 20 — Abstract.
- ◇ Apr. 17 — Presentations begin.

Guidelines for project deliverables are to be posted on the web side.

VIII Policies

1. All assignments are to be done individually. Students caught cheating will not receive a passing grade.
2. Homeworks will be collected in class on the day due.
3. Late assignments will be penalized 25% per day.
4. Make-up exams are not allowed. except in very dire circumstances (e.g., severe illness). In any case, the instructor must be informed in advance of the scheduled exam time.